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Industry Interface in Undergraduate Civil Engineering Education: Indian Context

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Abstract

Undergraduate civil engineering education is a professional education which demands its interaction with industry vis-a-vis the society. The present paper first presents a concise description of the history of development of the higher technical education in India mainly to highlight the different salient features in the context of the objective of the paper. It also gives a presentation of the existing scenario of the effective industry-interface system in the undergraduate civil engineering education in South Africa based on author's direct experience in order to emphasize the need and relevance of such a system in the context of the national development in the field of physical infrastructure etc. Finally, the author, in his concluding remark, proposes an industry-interface scheme for adoption and implementation.

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1. Introduction

It is imperative that undergraduate civil engineering education, being a professional education, needs its integration with civil engineering industry. To this end, attempts should be made to expose the civil engineering students as far as possible, to the real life situations of civil engineering profession in a holistic sense, through a systematic implementable scheme of industry-interface in place as a compulsory component of the undergraduate civil engineering curriculum. Such schemes have been existing in many countries across the world since long with note-worthy success. It is believed that some of the existing accreditation systems in different countries are adequately

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equipped in addressing this important aspect of undergraduate civil engineering curriculum, while some other countries are possibly in need of reforming their accreditation systems for the purpose. The core issue here is the effective implementation of a result-oriented industry-interface system embedded in the conduct of undergraduate civil engineering programme.

The present paper deals with this core issue of industry-interface in undergraduate civil engineering education as applicable to the prevailing scenario in India from the point of its historical development till present, with due considerations for some of the ones in existence, in other parts of the world.

2. Development of Higher Technical Education in India

The real beginnings of the development of higher technical education in India is synonymous with the origins of the Indian Institutes of Technology (IITs), (1); a committee was appointed by ‘the Hon’ble Member of the Viceroy’s Executive Council, Department of Education, Health and Agriculture’ in 1945 and its mandate was ‘to consider the development of Higher Technical Institutions in India with a view to ensuring an adequate supply of technical personnel which will be required for post-War industrial development in this country’. The terms of reference of the committee suggested different possible models (e.g., whether there should be a central institution on the lines of the Massachusetts Institute of Technology with a number of subordinate regional institutions or several higher institutions on a regional basis, or else), and charged the committee with the task of specifying the scope, size, control, management, cost, etc. of the institutions that it suggested establishing. Finally, the committee recommended establishment of four higher technical education institutes, one in the north, one in the east, one in the south and one in the west of India.

Before coming back to the further details about the IITs, it would be prudent to take stock of the facilities for higher technical education that existed in India in its pre-Independence days. Historians of technical education in India have noted that the foundations of technical education in India were laid almost concurrently with those in Europe but its growth remained halted till India became independent. In Europe, and more specifically in Britain, it was the Industrial Revolution that gave impetus for the growth of technical education in the late eighteenth and early nineteenth centuries; in India, the impetus was due to the newly industrialized colonial powers’ need to increase the knowledge about the topography and resources of a land that had newly come under its political authority. The earliest technical school the British traders opened in India was necessarily a survey school at Madras in 1794 to train Indians in modern land survey for assisting the British surveyors. Since then, and till the time the colonial government ruled India, the major initiative of starting new centres for technical education came only out of the necessity of the British rulers for training middle level technical personnel required for construction and maintenance of public buildings, roads, canals, ports and harbours, railways and other services, as well as for training artisans and craftsmen in the maintenance of instruments and equipment needed for army, navy and other technical establishments. Technical schools for training artisans and artificers, attached to ordnance factories and other engineering establishments, were established as early as in 1824 at Calcutta and Bombay. An industrial school was established in Guindy, Madras, in 1842, and attached to the Gun Carriage Factory there; a school for the training of overseers was established at Poona in 1854.

The need for the introduction of occupational education was emphasized in 1854, but the first college for training in civil engineering had already been established in 1847 at Roorkee. More training facilities became engineering colleges: Bengal Engineering College at Shibpur in 1856, Poona Engineering College in 1854, and Guindy Engineering College around the same time. Indian Education Commission of 1880-82, emphasized the role of technical education in the development of the economy and industry of India. The report of this commission presented a comprehensive observation of the prevailing situation and made some very sound recommendations for the promotion of technical education as an instrument of national progress. But the government shelved the report as the system of technical education in India was designed primarily to produce trained manpower required for running a colonial system of government and to support an industrial society in the United Kingdom, and not to develop human resources for running efficiently an industrial society in India. Under the framework of this policy, some more technical institutes were opened during the nineteenth century, like the Victoria Jubilee Technical Institute (VJTI) in Bombay. Started in 1887 to commemorate the Diamond Jubilee of Queen Victoria’s reign, its primary objective was to train licentiates in electrical, mechanical and textile engineering and technology. But, overall, industrial progress in India remained low during nineteenth century and so remained the progress of technical education.

At the beginning of the twentieth century, additional drive was undertaken by Indian nationalist leaders for furthering the Indian technical education for making the desired progress towards a free and strong India. A college of engineering was established at Jadavpur (Calcutta) under the auspices of the National Council of Education; it offered diploma-level courses in mechanical (1908) and chemical (1921) engineering. Indian Institute of Science at Bangalore was founded in 1909 by Sir Jamshedji Tata. Pandit Madan Mohan Malaviya established Banaras Hindu University in 1916, where he started a comprehensive degree course in electrical and mechanical engineering despite opposition by the Indian Industrial Commission (1915-17), which opined that such courses were not necessary as 'there was hardly any scope for employment of such persons except in the field of repair and maintenance of electrical machinery, for which facilities were already available'. Calcutta University started its College of Science and Technology in 1920, initially limiting itself to courses in civil engineering only.

After World War I, the Government of India was forced to grant some concessions to Indian Industry under nationalist pressure but organized industry was still confined mostly to textile and chemicals. There was rarely any heavy and capital goods industry and very limited interest in engineering and metal works. Electrical power – essential for large-scale industrial development was still undeveloped. Technical employment was limited mostly to textile and construction industries. Hence there was very insignificant progress in technical education. Till the end of 1930, there existed only ten institutions offering engineering courses mainly in civil engineering. Among these were Harcourt Butler Technological Institute (HBTI), Kanpur (established in 1921); Bihar College of Engineering, Patna (1924); Indian School of Mines, Dhanbad (1926); Andhra University, Vishakhapatnam (1933); University Department of Chemical Technology, Bombay (1934); Aligarh Muslim University, Aligarh (1935). These colleges continued to award degrees in civil, electrical and mechanical engineering but, at the national level, there was a lack of coordination among them on issues of content and duration of the programmes they offered, which exist even today.

In 1934, Sapru Committee, formed to report unemployment in United Provinces, made a recommendation to the government that 'there was need for diversification of industry by starting ship building, aircraft manufacturing, heavy chemicals, military industry etc., and for training suitable manpower for these industries. As this recommendation did not conform to the defined government policy regarding the future of Indian industry and economy, the report was shelved. Instead, two British experts, Abbot and Wood, were asked to formulate a report on the problems of vocational and technical education. These two gentlemen recommended major reform in the education system by implementing complete hierarchy of vocational and technical education parallel to that of general education, 'Delhi Polytechnic (later became Delhi College of Engineering) was established based on this recommendation. The start of World War II was the turning point in the history of technical education in India. In 1944, the government created a Department of Planning and Development under the guidance of Sir Ardeshir Dalal, a member of the viceroy's Council of Ministers. He believed that fast progress in science and technology would make it possible to develop industry and agriculture in fast pace and would cure all economic ills. But, for this, large scale expansion of technical education would be absolutely necessary. Accordingly, Sir Dalal took two important steps: (1) The establishment of a Department of Scientific and Industrial Research (which later on became Council of Scientific and Industrial Research) and (2) the appointment of the Sarkar Committee in 1945 to suggest steps for the development of higher technical education in India.

The Sarkar committee recommended setting up not less than four regional higher technical institutions based on the consideration for (1) post War requirements, (2) the geographical position of industrial areas, (3) the location of the existing technical institutions, and (4) the need for integrating the new four institutions with the requirements of existing industries and existing technical institutes. To ensure quality in their educational programmes, the committee proposed that the standard of graduation in these institutions should not be lower than the standard at a first-class institution abroad. The committee recommended that all the institutes would of course offer undergraduate (UG) instruction in the main branches of technology including civil engineering. Regarding the course of study, the committee stated that: 'The course of study in an institution should…. be designed to provide a combination of fundamental scientific training with a broad human outlook which will afford the students the type of collegiate education endorsed by leading engineers – one which avoids on the one hand the narrowness common among students in technical colleges and, the superficiality and lack of purpose noticeable in many of those taking academic college courses.

Subsequently, during the period 1950-60, four IITs were set up: IIT Kharagpur, IIT Bombay, IIT Madras, IIT Kanpur, based on the Sarkar Committee recommendations, with civil engineering as one of the major academic departments in each of these four IITs. Now there exist a total of 18 functioning IITs and 5 more are planned to be established in about next 2 years, and most of these IITs are having civil engineering in their academic programmes. There are also 31 National Institutes of Technology,1 Indian Institute of Engineering Science and Technology and host of other institutions, all having civil engineering in their academic programmes. Thorough review of the history of development of the undergraduate civil engineering education in India depicts that the existing programmes, since their inceptions, are predominantly having no, or at the most, insignificant interaction with industries in respect of formulating the curriculum and their implementation. The question, thus, arises about the outcome of this civil engineering education, and the way forward in reforming the systems in order to incorporate the important element of industry-interface on compulsory basis.

3. Some Observation from the civil engineering UG programmes from other countries

Here, primarily, the author is presenting his observations based on his experience in working as Professor of Civil Engineering at the School of Civil Engineering (SCE), University of Kwazulu-Natal (UKZN), Durban, South Africa during 2008-2010, on leave from IIT Kanpur (IITK) (2).

At SCE, UKZN, they operate their 4th year civil engineering (CE) Design Project (compulsory for the students of the 4th year CE programme) on almost 50-50 industry-institute participation based students' scope of work distributed out of a real-life project. The author is much impressed by their structured and disciplined organization in executing this, in which industry participates whole-heartedly under the coordinator ship of one adjunct faculty member having extensive industry experience together with adequate academic background (Masters from Imperial College, London). In this, the other CE faculty members participate, as needed, to advise the students on different aspects of the project on their individual expertise. Different lectures, workshops and site-visits are organized for exposing the students to the real-life situations, with extensive participation of industry experts. The students are assigned scope of work first group-wise in the initial phase, followed by individual scope in the next phase, all out of the same real project. Students are evaluated in both these phases, on the completion, jointly by the industry experts and internal faculty. All these are nicely structured conforming to the UKZN academic requirements and the stipulations of Engineering Council of South Africa (ECSA). They also have compulsory 4th year UG dissertation. The programme has all the components of core courses, professional courses and electives; however, the professional courses are as per the requirements of university and ECSA. Most of the students in CE are awarded bursaries by the CE industries from their very first year of the 4-year programme, with the condition that the students have to work for some minimum number of years in the respective organizations on graduation. It looks like this is a practice-based teaching-and-learning process, and the entire South Africa is tuned to this method of UG civil engineering education. All their UG engineering programmes are required to be accredited by ECSA, which has the conformance to the accreditation requirements standards of USA. Perhaps, this uniformity in engineering education standard is reflected in the excellent standard of their civil and other infrastructures, both in terms of building new ones and in maintaining the existing ones.

This illustrates amply a representative implementable scheme of industry-interface as a compulsory component of UG civil engineering curriculum. Similar such schemes are in operation in many countries across the world since long with enviable success, (3,4).

4. Concluding remarks

The author, based on his experience of last 28 years as a civil engineering faculty member at IIT Kanpur and other experiences gathered from his interaction with many organizations and individuals of the profession, has arrived at the following proposed scheme on industry-interface in UG civil engineering education: Following formed the basis of the scheme:

- UG civil engineering educational programme is a professional programme and it is imperative that it demands its interaction with industry vis-à-vis the society without any exception.
- Need to have embedded industry involvements and orientations in the UG civil engineering programmes thorough suitable industry interfacing systems installed on permanent basis.

- The industry interfacing to be done without affecting the good traditions of the existing systems and without making any sacrifice for the academic standards, in any way.
- Promotion of the culture of having meaningful industry-institute relations on a permanent basis in the context of this professional education.

The author proposes the following scheme for adoption and implementation:

- Establishment of an industry interface cell in the civil engineering department of an institution manned, primarily by one person, on permanent basis.
- Job description of the post would be inclusive of everything for holding the post responsible for effective interface between industry and faculty, including conduct of UG projects, students' industrial training, and other direct or indirect academic elements, having desirable contexts.
- The post, for example, in case of UG projects, would be responsible for procuring real life projects as topics. Such projects could be the ones under implementation at different possible stages of development/execution of which the associated industry experts would be willing to participate in providing all necessary information/exposure to the students through lectures, workshops, site-visits etc. The industry experts should also be available for working as examiners for evaluating the students' performances, jointly with the faculty. It is imperative that the post would be responsible to plan and schedule all these activities complying with the academic standard of a civil engineering UG programme.

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